

Fractional excretion of potassium in normal subjects and in patients with hypokalaemia

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Summary

The aim of our study was the determination of fractional excretion of potassium (FEK⁺) in both normal subjects and hypokalaemic patients. Three hundred and twelve normal subjects aged 21–69 years and 84 hypokalaemic patients aged 36–72 years were studied. The mean FEK⁺ in normal subjects was 8% (range 4–16%). FEK⁺ was positively correlated with serum potassium ($r = 0.74$, $p < 0.0001$) and inversely with serum creatinine ($r = -0.51$, $p < 0.001$). The mean FEK⁺ in patients with hypokalaemia of extrarenal origin was 2.8% (range 1.5–6.4%). On the contrary, the mean FEK⁺ in hypokalaemic patients in whom renal potassium loss was the main aetiological factor for the pathogenesis of hypokalaemia was 15% (range 9.5–24%).

Keywords: fractional excretion of potassium, hypokalaemia

Introduction

Measurement of urinary potassium excretion is very helpful in the differential diagnosis of both hypokalaemia and hyperkalaemia.^{1–3} To determine urinary potassium excretion it is preferable to collect a 24-hour urine sample. However, this is not feasible in many cases. Random measurement of the urinary potassium concentration is simple to perform but may be less accurate than a 24-hour collection, since it is influenced by two independent factors: K⁺ secretion and water reabsorption in the medulla.^{1,2,4,5} Therefore, the fractional excretion of potassium (FEK⁺) has been proposed as a useful diagnostic tool.^{2,6} This index relates the amount of potassium excreted to the amount filtered. However, the values of FEK⁺ are not well known either in normal subjects or in hypokalaemic patients and are sometimes used arbitrarily. The aim of our study was the determination of FEK⁺ in normal subjects as well as in patients with hypokalaemia of various causes and pathogenetic mechanisms.

Materials and methods

Three hundred and twelve normal subjects (213 male, 99 female) aged 21–69 years and 84 hypokalaemic patients (50 male, 34 female) aged 36–72 years with serum potassium levels

1.9–3.1 mmol/l were studied. The causes of hypokalaemia are shown in table 1. Patients with diabetes mellitus and acute or chronic renal failure were excluded from the study. In all patients and normal subjects venous blood was carefully obtained and serum potassium and creatinine were determined. Moreover, a fresh urine sample was tested for creatinine and potassium. Serum and urine potassium concentrations were measured by flame photometry. Serum and urine creatinine concentrations were determined by the method of Harre.⁷ Fractional excretion of potassium was calculated from the equation:

$$\text{FEK}^+(\%) = \frac{\text{urine K}^+ \times \text{serum creatinine}}{\text{serum K}^+ \times \text{urine creatinine}} \times 100$$

Linear regression analysis was used for the correlation between parameters.

Results

Laboratory parameters in normal subjects and hypokalaemic patients are shown in table 2. The mean value for the FEK⁺ in normal subjects was 8% (range 4–16%). FEK⁺ was positively correlated with serum potassium ($r = 0.74$, $p < 0.0001$) and was inversely correlated with serum creatinine ($r = -0.51$, $p < 0.001$). The mean value for the FEK⁺ in patients with hypokalaemia of extrarenal origin was 2.8% (range 1.5–6.4%). FEK⁺ was positively correlated with serum potassium ($r = 0.81$, $p < 0.001$), and was inversely correlated with serum creatinine ($r = -0.44$, $p < 0.05$) in this group of patients. The mean value for the FEK⁺ in patients with hypokalaemia of renal origin was 15% (range 9.5–24%). However, FEK⁺ was not correlated with serum potassium or with serum creatinine in this group of patients, even though these variables are included in the calculation of FEK⁺.

Discussion

It has been suggested that FEK⁺, an index of potassium excretion for a given serum level, is a relatively reliable and convenient marker of potassium excretion.^{1,2,6} However, normal values from a large sample of subjects are lacking. Our study showed that the FEK⁺ in normal subjects varies greatly and is correlated with serum potassium and renal function. It has been stated that the determination of FEK⁺ is helpful in the differential diagnosis of

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Table 1 Causes of hypokalaemia

Extrarenal origin (<i>n</i> = 44)	Renal origin (<i>n</i> = 40)
Prior diuretic therapy*	Recent consumption of diuretics** 15
Increased gastrointestinal losses (diarrhoea)	Hypomagnesemia 9
Alcohol withdrawal syndrome with severe respiratory alkalosis	Administration of penicillin derivatives 6
Treatment of megaloblastic anemia with B12	Mineralocorticoid excess 7
Administration of β -adrenergic agonists	Vomiting and metabolic alkalosis

* The diuretic drugs used were hydrochlorothiazide and furosemide. Urine samples were collected at least 24 hours after the last dose of the drugs. **Urine samples were collected within the first 6 and 24 hours after the last dose of furosemide and hydrochlorothiazide, respectively

Learning/summary points

- FEK⁺ is a useful diagnostic tool in the differential diagnosis of hypokalaemia
- FEK⁺ in normokalaemic subjects ranges between 4 and 16%
- FEK⁺ in patients with hypokalaemia of extrarenal origin ranges between 1.5 and 6.4%
- FEK⁺ in patients with hypokalaemia of renal origin ranges between 9.5 and 24%
- In hypokalaemic patients a FEK⁺ of more than 6.5% is indicative of inappropriate kaliuresis

Table 2 Laboratory parameters of normal subjects and hypokalaemic patients (mean \pm SD (range))

Group	Serum potassium (mmol/l)	Serum creatinine (μ mol/l)	FEK ⁺ (%)
Normal subjects (<i>n</i> = 312)	4.2 \pm 0.3 (3.6–5.2)	80 \pm 18 (53–124)	8 \pm 2 (4–16)
Hypokalaemia of extrarenal origin (<i>n</i> = 44)	2.4 \pm 0.3 (2–3.1)	88 \pm 18 (56–121)	2.8 \pm 1 (1.5–6.4)
Hypokalaemia of renal origin (<i>n</i> = 40)	2.5 \pm 0.3 (1.9–3)	90 \pm 24 (58–121)	15 \pm 2 (9.5–24)

FEK⁺: fractional excretion of potassium

hypokalaemia. In such patients a FEK⁺ less than 6% is consistent with appropriate potassium conservation.² However, in a recent study inappropriate kaliuresis was considered when FEK⁺ was more than 13%.⁸ Our study clearly showed that in patients with hypokalaemia of extrarenal origin FEK⁺ is less than 6.5%. In other words, a FEK⁺ more than 6.5% is

indicative of inappropriate potassium loss. In fact, FEK⁺ is more than 9% in all patients with hypokalaemia of renal origin.

In conclusion, in hypokalaemic patients with normal renal function FEK⁺ is a very useful tool in the diagnosis approach of hypokalaemia. A value of more than 6.5% is indicative of inappropriate potassium loss.

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